THE CONSTRUCTION OF A THERMOSTAT-ROOM.

By NORMAN MAC LEOD HARRIS, M.B. (Tor.).

(*Instructor in Bacteriology, University of Chicago.*)

Plate XXVII.

The receipt by the author of a number of inquiries regarding the building of a thermostat-room has led him to bring together in a brief paper certain facts which might prove of value to those interested in the subject.

Every well-appointed bacteriological laboratory, in which teaching of large-sized classes is carried on, should be equipped with an incubator-room, for experience has shown that the costly copper thermostat, even of largest size, is entirely inadequate to afford proper service, and, therefore, the question resolves itself into one of two alternatives, namely, that of furnishing two or more ordinary thermostats at a considerable expense, or of erecting a thermostat-room at a much less price and with the additional advantage of better service.

After having seen in 1901 a rather rudimentary thermostat-room in Copenhagen, Denmark, and having had a hurried and unsatisfactory glimpse of a thermostat-room in the Institute for Infectious Diseases in Berlin, plans were prepared to suit the conditions found in the pathological laboratory of the Johns Hopkins University, where a very limited floor-space was the chief obstacle in the way of the erection of an ideally constructed room. The room had, furthermore, to be built independently of the walls of the laboratory, as these formed the outer corner-walls of the building, and the plastering inside was placed directly on the bricks, thus compelling the abandonment of their use in forming the walls of the incubator, since this construction would have resulted in too great and constant absorption of heat.

The framework of the incubator-room consisted of moderately heavy pine scantling, properly joined and covered on the outside with three-quarter inch dressed and matched white-pine boards, and on the inside with rough one-inch boards, enclosing a space six inches in width between on all sides, except beneath the floor, where the space was three inches, thus forming an apartment whose inside measurements were 8 feet high, 5.5 feet wide, and 4.5 feet deep. A door 6 feet high and 24 inches wide, having the same construction as the walls, opened outwards on the longer wall at one end, and an inner sliding door with a glass window was provided to prevent the loss of heat when the outer door was opened. The whole of the inside walls and ceiling was covered with carefully matched linoleum, which was afterwards varnished. Ventilation was provided for by two apertures two inches in diameter, one being placed three inches above the floor in one corner of the room and protected against the entrance of rats and mice by a wire grating, the other in the centre of the ceiling, both being provided with sliding valves to permit of regulation of the change of air.

Seven rows of shelving, approximating 56 feet in length, made of one-inch dressed pine, 12 inches wide, were installed on the side opposite to and on the end farthest from the entrance.

The room was lighted by a 16 candle-power incandescent electric lamp on a wire carried in through the ceiling ventilator, and controlled by a switch placed outside on the lintel of the door.

The heating was the main problem connected with the design, and after much consideration hot water was decided upon as the most efficient medium to be employed. The apparatus consisted of a ten-gallon galvanized iron boiler placed on an iron stand some eight or nine inches high. From the centre of the upper surface of the boiler one-inch piping was carried into the room at the end farthest removed from the entrance, and back and forth down the side and along three-quarters of the length of the opposite end of the room, forming four rows of piping, comprising a total length of 48 feet, the lowermost end passing outside on a plane level with the lower end of the boiler with

which it connected (Fig. 1). An air valve with cock was affixed to the outflow pipe immediately where it leaves the boiler, being carried upwards some three or four inches to trap effectually the air which might have accumulated during the filling of the pipes. A cock was affixed to the return flow pipe near the boiler for the purpose of emptying the system when necessary.

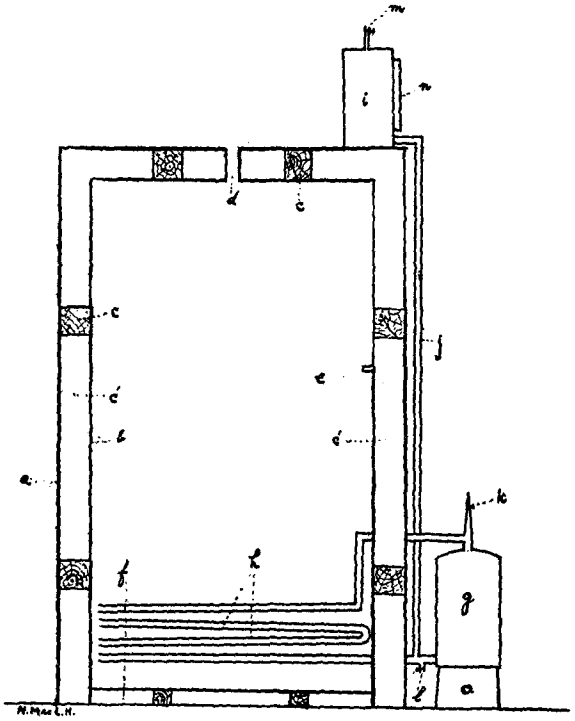

FIG. 1.

End Sectional View of Thermostat-Room and Heating Apparatus.
(Scale $\frac{1}{2}$ in. to 1.5 ft., approximately.)

a. Outer wall of matched pine boards. b. Inner wall of undressed pine boards. c. Framework of scantling. c^1. 6 in. interspace filled with slag wool. d. 2 in. ventilator in ceiling. e. Shelf for thermoregulator. f. Interspace 3 in., like c^1. g. Boiler, 10-gallon capacity, 20 x 12 in. h. Radiating pipe, 1 in. i. Expansion tank, 5-gallon capacity, 18 x 9 in. j. Pipe, $\frac{3}{4}$ in., connecting tank with boiler. k. Air-cock. l. Water-cock for draining heating system, or for filling it. m. Air or water-cock. n. Gauge. o. Space below boiler (enclosed) for Koch safety-burner.

Since the thermostat-room was on the same level as the floor of the laboratory, and it was desired to keep the heating surfaces as low down as possible, and as the boiler outlet had then unavoidably to be on a plane higher by twelve inches than the desired level of the uppermost line of piping inside, the difficulty of securing proper circulation was met with at the outset. As it was impossible to install the boiler in the room below, the following device was resorted to in order to supply *vis a tergo:* a five-gallon expansion tank fitted with a glass water-gauge was erected on the roof of the incubator directly over the boiler, at a height of about ten feet, connection being made with the return flow pipe close to the boiler by means of three-quarter inch piping (Fig. 1). This device proved entirely satisfactory, the resistance which might have been offered, caused by the sudden drop of twelve inches in the outflow level, being entirely overcome and the circulation being quite rapid.

The system was filled by carrying a line of hose to a cock on the upper surface of the expansion tank, but it might have been done equally well by making a similar connection with the exhaust cock below.

The gas supply entered the room from above through a half-inch pipe connecting with and passing through a Lothar-Meyer ether-mercury regulator, thence by means of quarter-inch lead pipe to a large-sized Koch safety-burner placed beneath the boiler. The temperature was readily enough maintained at 37° C., except during very cold weather, when it fell to 34° C. This fall was explained by reason of the fact that the steam heat supplied to the laboratory was always cut off at night, and the boiler having been placed immediately below a large window readily lost a considerable amount of heat by radiation. This last drawback could probably be overcome by plastering the boiler all over with asbestos plaster to the depth of one inch.

The cost of the completed room, exclusive of the thermoregulator and the Koch safety-burner, was one hundred and twenty dollars, which sum is often exceeded by the cost of the larger sizes of the ordinary copper-built apparatus.

Naturally enough the incubator did not prove perfect, and

after it had stood the test of a session's work certain imperfections and shortcomings were noted, to which brief consideration will be given.

In the first few weeks after starting the apparatus, considerable difficulty was experienced by reason of the air accumulating in that portion of the outflow pipe at or near the downward bend inside the room (Fig. 1), causing a stoppage of the circulation. This difficulty could be remedied by bringing the pipe into the room on a slight slope before dropping it down, thus permitting the air to flow upwards to the air valve without any hindrance.

The plastering of the boiler has already been mentioned as a desirable improvement.

It would be an advantage to place the boiler at a lower level than the pipes, not indeed by carrying the pipes higher up on the wall, but by placing the boiler on a lower floor of the building directly beneath the incubator. Still other means of accomplishing this end might, however, suggest themselves.

A more satisfactory gas regulator than the Lothar-Meyer is the Roux bi-metallic regulator, as it rarely requires attention and hence it could be substituted with advantage in the construction of the room.

Automatic lighting of the room would be a further improvement. This could be accomplished by some style of door connection whereby the light would be turned on upon opening, and shut off on closing, the outer door.

The shelving might be replaced advantageously by the erection of a series of individual drawers, constructed so as to permit of the free circulation of the heated air of the room among them.

A vestibule with swinging door would be a benefit, since it would prevent too great loss of the warm air of the room on the opening of the thermostat door.

In presenting this paper it is the writer's intention to suggest a plan which applies to those cases only in which facilities for making alterations in a building to meet more properly the demands of a large bacteriological class cannot be carried out. Where a new building is being erected, or alterations are being carried out on an old one, the scheme as outlined in the fore-

going description can doubtless be rendered more simple and less expensive.

ADDENDUM.

Since the foregoing paper was presented, I have had the privilege of inspecting a thermostat of much smaller dimensions but built on similar lines to the one above described. It is in the laboratory of the Thomas Wilson Sanitarium for Sick Children at Mount Wilson, Md., and was made from the designs of Dr. V. H. Bassett of the Johns Hopkins University Medical School, to whose kindness I am much indebted for the accompanying diagram and the permission to make use of the data of construction.

The thermostat was set up on the work-bench in one corner of the laboratory, and was in use during the summers of 1903 and 1904, and gave entire satisfaction.

Its inside measurements were 106 cm. high, 72 cm. wide, and 72 cm. deep, giving a capacity of 0.55 cb.m. It was built upon a wooden framework, using on the inside one-half inch dressed pine boards, afterwards covered by linoleum, whilst the outside was covered by ordinary wainscoting; the inner and outer walls inclosing a space of 6 cm. wide which was packed with cork shavings (Fig. 2). Three movable wooden shelves were set up 20 cm. apart. Holes 2.5 cm. in diameter were bored upon the top to permit ventilation, and to take a thermoregulator and a thermometer; a hole of similar size, for the inlet of air, was made on one side low down. Two doors were provided, an inner and an outer, equal in height and width to the measurements of one side of the apparatus. The door-jamb was faced with felt all around so that the inner door (which was covered on its internal surface with linoleum) might fit closely.

Hot water being the medium employed to furnish heat, the necessary apparatus for such a system consisted of a boiler, circulating pipes, and expansion tank. The boiler was made of galvanized sheet-iron soldered together, measuring 26 x 17 cm., with a capacity close to six litres, and placed upon a covered stand on the floor of the room beneath the thermostat.

Running from it and leading into the incubator was a galvanized iron pipe, having an inside diameter of 1.25 cm., and disposed in eleven rows along the back wall of the incubator

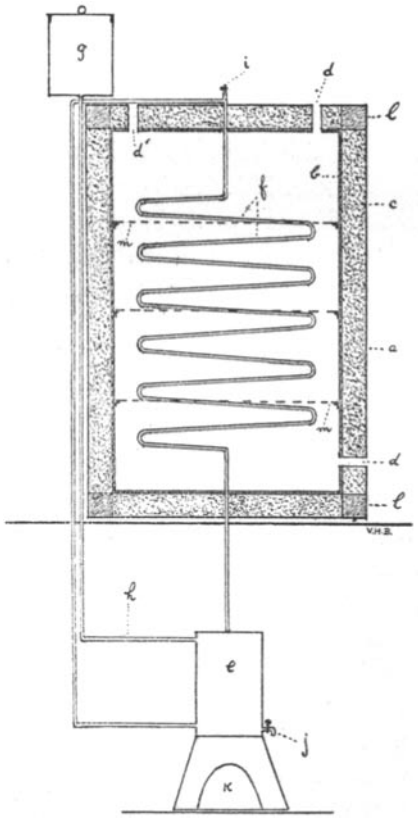

FIG. 2.

End Sectional View of Dr. Bassett's Thermostat (scale about $\frac{1}{20}$).

a. Outer wall of matched pine boards. b. Inner wall of dressed pine. c. 6 cm. interspace filled with cork shavings. d. 2.5 cm. ventilation shaft. d^1. Shaft for thermoregulator. e. Boiler, 17 x 26 cm., capacity 6 litres. f. Radiating pipe. g. Expansion tank, 20 x 16 cm., capacity 4 litres. h. Pipe, connecting tank with boiler. i. Air-cock. j. Water-cock. k. Space below boiler for Koch safety-burner. l. Wooden frames. m. Position of shelving.

in zig-zag fashion; as it passed out it was capped with an air-cock, after which it continued downwards to the lower part of the boiler. The piping gave, approximately, 4140 square cm.

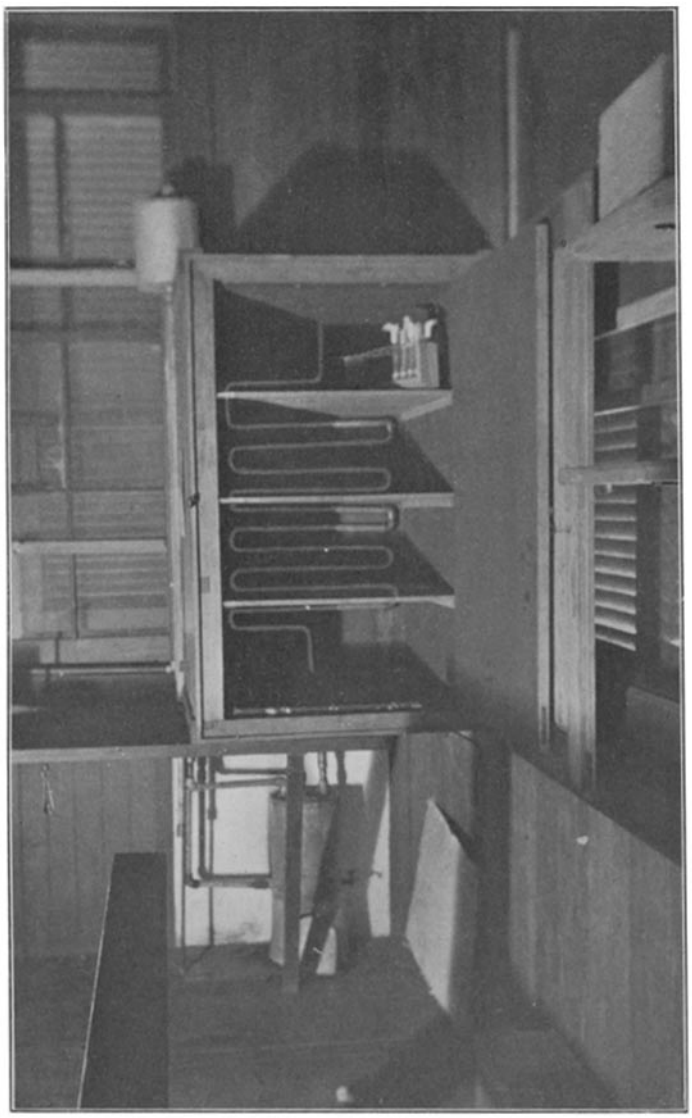

FIG. 3.

Photograph of Dr. Bassett's thermostat in the Thomas Wilson Sanitarium for Sick Children.

of radiating surface. The expansion tank consisted also of galvanized iron soldered together and provided with a cover; it was connected to the upper parts of the boiler and measured 20 x 16 cm., and had a capacity of about four litres.

The thermoregulator was of the Reichert type and the boiler was heated by a Koch safety-burner of ordinary size.

The actual cost of materials, some of which were lying ready at hand, was $11.00, a workman's wages was $7.00, making a total cost of $18.00; if made by contract, the price doubtless would approximate $25.00.